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QUARTELY PROGRESS REPORT. JANUARY 1-MARCH 1, 1971

Pacific Northwest Water Laboratory

Prepared for:

Environmental Protection Agency

April 1971

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QUARTERLY PROGRESS REPORT

PACIFIC NORTHWEST WATER LABORATORY CORVALLIS, OREGON

JANUARY 1—MARCH 1, 1971

ENVIRONMENTAL PROTECTION AGENCY

WATER QUALITY OFFICE

NORTHWEST REGION

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PACIFIC NORTHWEST WATER LABORATORY

QUARTERLY REPORT

January 1 through March 31, 1971

Environmental Protection Agency
Water Quality Office
Northwest Region
Corvallis, Oregon

April 1971

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NATIONAL EUTROPHICATION RESEARCH PROGRAM

PPB 1601

Status of Projects and Significant Accomplishments

Work Plan ZCB: Assay Procedures for Determining Productivity Responses

A second interlaboratory precision test of the Provisional Algal Assay Procedure has been completed and the data are being analyzed. Eight laboratories participated in the test. The assay was performed on two lake water samples; a common sample provided by this laboratory and a sample collected in the area of each participating laboratory.

A draft of "Algal Assay Procedure: Bottle Test" has been completed and is being sent out for review to participating laboratories. In addition to a complete description of the conduct of the assay, the document also contains eleven appendices. These relate to various areas of research carried out in the assay evaluation and also results and discussion of the interlaboratory precision tests.

The winter sampling of nine Oregon lakes was completed, and algal assays and chemical analysis were conducted on the water samples. These lakes are being sampled on a seasonal basis to study the changes in algal growth responses at different times of the year.

Efforts are being made to isolate and culture freshwater diatoms suitable for assay test organisms.

Work Plan CND: Lake Restoration Techniques

NERP and the Advanced Waste Treatment Program at Cincinnati, Ohio have been working closely with the City of Ely, Minnesota and its

consulting Engineers and Architects in preparing a proposal for a grant for construction of an advanced waste treatment plant at Ely. It is expected that the proposal will be submitted in mid-April. In the meantime chemical, physical and biological monitoring of Shagawa Lake is continuing. Also a mathematical modeling program of Shagawa Lake is being developed with consultation from personnel at Oregon State University.

Characterization of 31 sediment samples from Shagawa Lake was completed and the statistical evaluation is in progress at Battelle-Northwest.

Laboratory equipment has been fabricated for sediment-water interchange experiments on Shagawa Lake to be conducted in a newly-assembled constant temperature room. A cooperative plan of a sediment-water interchange study has been worked out for Shagawa Lake with Batelle-Northwest.

Field and laboratory preparations have been completed to conduct a full-scale nutrient inactivation experiment on Cline's Pond near Corvallis.

Personnel met with the Albany (Oregon) Parks and Recreation Commission relative to experimental work on the Albany lakes. A draft preproposal for the removal of suspended sediments and soluble phosphorus from the Albany lakes inflow has been completed.

Nutrient and hydrologic budget workup of Lake Sallie, Minnesota has continued. This project is concerned with determining relative nutrient uptake by aquatic macrophytes from sediments and from water

and to evaluate the feasibility of removing nutrients from lakes by weed harvesting.

A bibliography on attempted full-scale lake restoration techniques has been compiled.

Other Activities

C. F. Powers and K. Malueg met with Mr. Winston C. Larson and Dr. Joe K. Neel at Fargo, North Dakota to discuss a preproposal for work on Lake Sallie, Minnesota. K. Malueg and K. Byram met with the NERP staff at Ely, Minnesota to discuss continued monitoring of Shagawa Lake and future research to be conducted there. K. Malueg attended an International Joint Commission briefing at the Canada Centre for Inland Waters, Burlington, Ontario to examine findings of a joint United States/Canadian limnological study on Lake Erie.

Publications and Presentations

Maloney, T.E., W.E. Miller, and T. Shiroyama. Algal responses to nutrient additions in natural waters: laboratory assays.

Powers, C.F., D.W. Schults, K.W. Malueg, R.M. Brice and M.D. Schuldt. Algal responses to nutrient additions in natural waters: field experiments.

Both of the above papers were presented at the American Society of Limnology and Oceanography Symposium on Eutrophication - The Limiting Nutrient Controversy at Kellogg Biological Station, Gull Lake, Michigan, February 10-12.

Miller, W.E. and T.E. Maloney, The effects of sewage upon the growth of algae in natural waters. Presented at the Meeting of the Weed Science Society of America, Dallas, Texas, February 9-11.

Brice, R.M. and C.F. Powers, The Shagawa Lake Project. Presented at Upper Great Lakes Section of the American Chemical Society at the University of Minnesota, Duluth.

Grant and Contract Research

The following research grant and contract proposals were reviewed.

1. "Research and Development of a Selective Algaecide to Control Nuisance Growth - Phase II"

2. "Estimation of Freshwater Ecosystem Parameters"

3. "The Effect of Micronutrien[illegible] on the Structure and Energy Transfer"

4. "Verification of Environmental Modeling of a Fresh Water Lagoon System in a Residential Community"

5. "A Systems Analysis of the Relation of Phosphorus to Water Quality in a Sewage Effluent Pond"

6. "Rational Control of Ecosystems Quality: An Eutrophication Economic Model"

7. "Monitoring and Nutrient Inactivation Studies on Two Glacial Lakes (Ohio) Before and After Nutrient Diversion"

8. "Estimating In Situ Nitrogen Fixation by Blue-Green Algae Using Heterocyst Enumeration"

9. "Eutrophication of Surface Waters - Lake Tahoe - Indian Creek Reservoir"

10. "Ecological and Physio-Chemical Cycles of Nutrients in Lakes"

11. "Aesthetic Restoration of Clear Lake, California"

12. "The Role of Sludge Worms in Promoting Eutrophication"

13. "Biological Models of Freshwater Communities"

14. "Eutrophication of a North Central Florida Lake by Artificial Enrichment"

15. "Leptopel as a Quantitative Biochemical Parameter of Productivity, Hypertrophication, and Recovered Fertility in Metropolitan Area Lakes"

16. "Natural Control of Eutrophication"

Plans for Fourth Quarter, FY 1971

Work Plan ZCB: Assay Procedures for Determining Productivity Responses

Complete final draft of Algal Assay Procedure: Bottle Test. Conduct laboratory algal assays in conjunction with the Shagawa Lake Restoration Project and the Cline's Pond nutrient inactivation study.

Conduct spring sampling program and conduct algal assay on nine Oregon lake waters.

Continue isolation and culture of freshwater diatoms for use as algal test species.

Work Plan CND: Lake Restoration Techniques

Conduct full-scale nutrient inactivation study on Cline's Pond. Further investigate prospects of nutrient inactivation treatment of Upper Swan Lake, Albany. Continue study of Lake Sallie nutrient and hydrologic budgets and tests on Shagawa Lake sediments. Begin construction of

laboratory apparatus for study on the stability of chemically inactivated phosphorus compounds and initiate discussions with U. S. Forest Service relating to eutrophication problems on Diamond Lake, Oregon.

Using a new coding system, all existing data on the Shagawa Lake Project will be put into the Sample Handling and Verification System (SHAVES). The grant applications for the advanced waste treatment plant at Ely (Shagawa Lake Project) will be completed and submitted. Monitoring of Shagawa Lake will be continued. Experiments will be conducted to determine the mode of phosphorus uptake in aquatic macrophytes.

The plans for the dredging of Lansing Lake, in cooperation with the Corps of Engineers and Michigan State University will be finalized.

NATIONAL WASTE TREATMENT RESEARCH PROGRAM

FOOD WASTES RESEARCH - PPB 1206

Status of Projects and Significant Accomplishments

Work Plan ZAQ: Technical Consultation and Data Dissemination

The Second National Symposium on Food Processing Wastes was held March 23 to 26, 1971, in Denver, Colorado. Thirty-four papers were presented to the 180 registrants.

Mr. Burm presented a paper titled "Cannery Waste Treatment with RBC and Extended Aeration Pilot Plants" at the Denver meeting.

Mr. Boydston was on the program of the Intermountain Food Technologists' annual meeting with an informal talk on the R, D and D grant program.

A talk titled "Dairy Industry Pollution Control: Preliminary R&D Results" was presented at the 60th Annual Conference of Oregon Dairy Industries by Mr. Burm.

Mr. Dostal presented "Federal Research to Reduce Waste Treatment Costs" at the Engineering Foundation Research Conference on Environmental Engineering in the Food Industry.

Mr. Boydston gave a status report at the National Canners Association's annual meeting on the food waste research efforts.

"Federal Research to Abate Food Wastewaters" was presented by Mr. Boydston at the Food Update 10 Management Seminar.

At the request of Regional Operations personnel Mr. Dostal visited and consulted with the WQO Anchorage Office, various city

(Kodiak) officials and most of the seafood processors in the city of Kodiak.

Discussed ongoing programs relative to pollution abatement from seafood processing wastes with Miss E. Gould, NOAA and Mr. W. Towne, consultant to State of Alaska.

Met with Autotrol Corporation (distributors of RBC) personnel and briefed them on results from RBC pilot plant at Salem cannery.

Members of North Star Research and Development Institute, and Penick and Ford Limited visited PNWL to discuss the use of fungi imperfecti for treating potato starch processing wastes.

Met with personnel from All-Ocean Products Holding Limited and B. H. Levelton & Associates Limited relative to a potential by-product recovery plant in Kodiak, Alaska (seafood wastes as raw material).

Work Plan FGF: Grant Monitoring

Mr. Dostal visited the following grant sites during the quarter:

American Distilling Co., Pekin, Illinois - 12060 FLL

Corn Products, Inc., Pekin, Illinois - 12060 DPE

City of Kodiak, Alaska - 11060 FJQ

City of Grand Forks, North Dakota - 11060 DJB

Western Potato Service, Inc., Grand Forks, North Dakota - 12060 EIG

American Crystal Sugar Co., East Grand Forks, Minnesota - 12060 ESC

Central Soya, Chicago, Illinois - 12060 FUR

Mr. Burm visited the following:

Ohio State University, Columbus, Ohio - 12060 EGU

Kent Cheese Co, Madison, Wisconsin - 12060 EKQ

Burm, Taylor and Dostal attended several meetings at various locations relative to "Industrial Waste Studies" contracts. Four of these contracts are monitored by the above, they include:

Canned and Frozen Fruits & Vegetables - 18000 HAQ

Dairy - 18000 HAS

Beverage - 18000 HBD

Grain Milling - 18000 HAV

The following grant proposals and preproposals were received during the quarter:

1. Low water volume enzyme deactivation of vegetables before preserving (revised).
2. Submerged combustion evaporation system for concentration of brewery spent grain liquors.
3. Use of fungi imperfecti in treatment of wastes from potato processing.
4. A study of cannery (tomato) wastewaters and of methods for treatment.
5. Dry caustic peeling of Clingstone peaches on a commercial scale.
6. The conversion of food processing waste to high quality dressed fish.
7. Food processing waste reduction through systems modeling and optimization.
8. Pollution abatement by seafood waste utilization, Kodiak Alaska.

Six final report drafts were received for technical review.

Work Plan GJJ: New and Improved Treatment Processes for Food Processing Wastes

Van Waters & Roger's United Centennial Mills processing plant in Spokane, Washington, started up their waste treatment plant in January 1971. The plant, consisting of three parallel anaerobic trickling filters will be monitored by NWTRP personnel. The startup phase is nearing completion - the treatment plant will be handling the entire waste load (P.E.~60,000) starting the early part of April. Preliminary data indicate that the COD load is being reduced by 80-85 percent (raw~10,500 mg/l) although gas has not been detected at the waste gas burner as yet.

Work Plan GKI: Secondary Treatment Processes for Highly Seasonal Wastes

Analysis of the data from the two pilot plants which were located at United Flav-R-Pac Cannery in Salem, Oregon has been completed and the final report is well underway. A summary of this work was presented at the Denver Symposium.

The RBC pilot plant was moved from the Salem cannery to a potato processing plant in Ontario, Oregon. Startup of the pilot plant was delayed because of cold weather and then a decision was made by management to terminate potato processing the first week of April 1971 instead of June as originally planned. Thus, this study will not be undertaken this year.

Grant and Contract Research

The current status of monitored grants is described below. These grants are in the process of being assigned to work plans.

1. 12060 EUZ: Winery Wastewater - Characterization and Treatment. Construction of the full-scale facilities has been completed and the treatment plant is being started.

2. 12060 EKQ: Kent Cheese Company - Waste Treatment Facility. Post construction studies are just getting underway.

3. 12060 FLL: Activated Sludge - Bio-Disc Treatment of Distilling Wastes. Construction of full-scale treatment facilities is about 40 percent completed.

4. 12060 EHS: Cannery Waste Treatment by Lagoons and Oxidation Ditch. The first draft of the final report will be revised prior to submittal to Project Reports System.

5. 12060 EHV: Aerobic Secondary Treatment of Potato Processing Wastes with Mechanical Aeration. The final report has been submitted to Project Reports System for reproduction.

6. 12060 DSI: State-of-the-art, Sugarbeet Processing Waste Treatment. The final report is being revised following a review of the second draft.

7. 12060 ECF: Water Pollution Abatement in the United States Seafood Industry--State-of-the-art. The final report has been submitted to Project Reports System for reproduction.

8. 11060 EZR: Complete Aerobic Treatment of Combined Domestic and Industrial Wastes with Mechanical Aeration. Preparation of the first draft of the final report continues.

9. 12060 EIG: Full-scale Demonstration and Evaluation of Potato Dry and Wet Caustic Peeling Processes. Data collection is still underway at both potato processing plants. Preliminary information shows a water use of 170 gallons per ton of raw potatoes (peeling systems only) for the dry peel and 2800 gallons per ton for the wet system although 80 percent of the latter is recirculated.

Suspended solids in the liquid waste stream are 34 and 126 pounds per ton of potatoes, respectively, with BOD loads in the primary clarifier effluent of 24 and 112 pounds per ton, respectively. The reported values for SS and BOD for the dry peel system should drop measurably as the season progresses.

10. WP-01486-01: Status and Research Needs for Potato Waste Waters. A final audit has been completed and a recommendation has been forwarded to officially terminate the grant.

11. 12060 FAD: Pollution Prevention by Aeration of Fruit Processing Wastes. Questions raised by the final audit are yet to be resolved.

12. WPD 93-04-68: Anaerobic-Aerobic Sugar Beet Waste Treatment. The first draft of the final report was submitted.

13. 12060 DXL: Reduction of Salt Content of Food Processing Liquid Waste Effluent. A final report draft is being reviewed.

14. 12060 EDK: Production and Disposal Practices for Liquid Wastes from Canning and Freezing Fruits and Vegetables. First final report draft is being revised.

15. 12060 EHT: Use of Fungi Imperfecti in Waste Control. Final audit completed but appendix of raw data has not been submitted.

16. 12060 EDZ: Pilot Plant Installation for Use of Fungi Imperfecti on Vegetable Wastes. First draft of final report recently submitted.

17. 12060 FAK: Concentration of Sugar Beet Wastes for Economic Treatment with Biological Systems. Final report still being revised.

18. 12060 FQE: Dry Caustic Peeling of Tree Fruit to Reduce Liquid Waste Volume and Strength. A revised draft of final report has been submitted for review. Results on experimental peeling of peaches were:

		Waste per ton of peaches	
Commercial	527 gal.	60 lbs COD	10 lbs SS
Experimental (dry)	35 gal.	18 lbs COD	3 lbs SS

Because of the above results a full-scale line will probably be installed this summer.

19. 11060 FJQ: Pollution Abatement and By-Product Recovery in Shellfish and Fisheries Processing - Phase I. Preparation of the final report is just starting.

20. 12060 EGU: State-of-the-art of Dairy Plant Wastes and Waste-Treatment Systems. First draft of final report is being prepared.

21. 12060 FDR: Disposal of Rum Distillery Wastes. Bench-top work on anaerobic digestion of rum distillery waste continues. A 500 gallon digestor is currently being built for larger scale experiments.

22. 12060 ESY: Improvement of Treatment of Food Industry Waste. Final report being revised.

23. 12060 EZP: Cannery Waste Treatment by the Kehr Activated Sludge Process. Final report distributed; audit procedures as yet not completed.

24. WPRD 151-01-68: Integrated Treatment of Liquid Wastes from Food Canning Operations. Final report submitted to Project Reports System for reproduction.

25. 12060 EHU: Reconditioning and Reuse of Food Processing Brines. Final report under minor revision prior to submittal to Project Reports System.

26. 12060 DQV: Removal and Recovery of Fatty Materials from Edible Fat and Oil Refinery Effluents. Revision of final report underway following first review.

27. 12060 DEQ: Elimination of Pollution by and Utilization of Protein Concentrates (Dried Whey) from Milk Residues of Cheese Making. Testing program is still underway.

28. 12060 DPE: Treatment of Wastes from the Wet Milling Industry. Construction of full-scale activated sludge plant was completed in January and the testing program initiated the first of February.

29. 12060 DSB: Demonstration of a Full-Scale Waste Treatment System for a Cannery. Final report being revised following reviews.

30. 12060 EAE: Evaluation of Controlled Temperature and Forced Aeration in Trickling Filter Treatment of Food Canning Waste Waters. Final report has been submitted for reproduction.

31. 12060 DXF: Development and Demonstration of an Ultrafiltration Plant for the Abatement of Pollution from Cottage Cheese Whey. Pilot plant evaluations of R.O. and U.F. for removal and recovery of protein and lactose concentrates have been completed. Economic projections are very favorable thus Phase II (full-scale) will probably be implemented.

32. 12060 FJK: Acid Emulsion Breaking - Activated Sludge for Bakery Waste. Construction of full-scale facilities is nearing completion.

33. 12060 ESC: Separation, Dewatering and Disposal of Sugarbeet Transport Water Solids. Limited pilot plant runs were made on thickening of primary clarifier sludge using polymers and various types of pressure and vacuum filters.

34. 12060 FUR: Membrane Separation of Soybean Whey for Product Recovery and Waste Treatment. Installation of R.O. and U.F. pilot plant equipment is being completed.

35. 12060 FTC: State-of-the-art Study of Water Pollution Control from the Beverage Industry. Approximately 40 percent of the study is completed.

36. 11060 DLF: Tertiary Treatment of Combined Domestic-Industrial Wastes. The tertiary units were shut down early January because of cold weather and, as yet, have not been restarted.

37. 11060 DJB: Controlled Treatment of Combined Potato Processing - Municipal Wastes by Anaerobic Fermentation, Aerobic Stabilization Process. Construction of full-scale facilities nearly complete.

38. 11060 DUJ: Dynamic Process Development for Biological Treatment of Whey Bearing Wastes. Final report being revised.

39. 11060 ENF: Vermont Cheese Industry Pollution Abatement. Project has not been initiated.

Consulting Services

Listed under work plan ZAQ.

Reports, Papers and Presentations

Listed under work plan ZAQ.

Plans for Fourth Quarter, FY 1971

1. Continue grant monitoring.
2. Major effort on assistance to Operations Program relative to Industrial Waste Studies.
3. Type, reproduce and distribute Proceedings from Denver Symposium.
4. Monitor full-scale anaerobic trickling filters.

PAPER AND FOREST INDUSTRIES RESEARCH - PPB 1204, 1210, 1301

Status of Projects and Significant Accomplishments

Work Plan FCK: Coliform, Suspended Solids and Color Removal (12040)

The in-house project, under direction of Dr. Willard, on chemical treatment of final effluent from aerated lagoons is progressing satisfactorily. Results of employing polymers and flocculants to Kraft lagoon effluent appear optimistic. Work on Kraft has involved the Weyerhaeuser Springfield mill, American Can at Halsey, and Western Kraft at Albany. We are investigating also the recycle of the sludge fraction to increase the MLSS in the flocculation step. With much smaller addition of polymer, excellent clarification has resulted with final sludge compaction to about one-third volume of the first cycle.

Arrangements have been completed for field work on the Weyerhaeuser, Cosmopolis, Washington, secondary system. Because of seasonal operation of the aerated lagoon, this will be delayed until mid-July. Because of

the known dispersant qualities of SSL, the results on the Lebanon ammonia base secondary effluent have been less satisfactory.

The Lebanon solids removal field project at the Crown-Zellerbach mill, under supervision of Mr. Shankland, has been delayed due to other demands on time and weather. We now have some added manpower and Mr. Ruppersberger is contributing part-time to the project. The aeration tank is installed. Plumbing is in process and arrangements have been completed with Crown-Z to handle the electrical hookup. We will, hopefully, be ready to operate by mid-May.

Work Plan ZAX: Pollutional Aspects of Bark Leachate (12100)

The bark leachate studies employing lysimeters with hemlock, alder, fir and cedar barks continued through this quarter. Data obtained has been partially developed for an interim report. The lysimeters will be kept intact for additional studies next winter after a summer season permitting increased bacteriological activity and bark deterioration.

Special Work Plan GJU: Technical Support (12100)

Mr. Scott was involved as a member of the OSU Forestry Laboratory committee to plan a meeting for Pacific Northwest mill operators on bark disposal. This conference was held at Oregon State University March 8-9 with about 150 registrants and provided a wide view of possible bark disposal methods by burning for fuel and heating, for mulching, by-product development and chemical extractives. By earlier calculations of this office approximately 2.3 million tons per year of green bark, formerly disposed of in wigwam burners, must eventually be diverted

to other disposal. One likely avenue will be land disposal with possible surface and groundwater contamination. We will be interchanging information with Oregon Department of Environmental Quality on this subject and working with them and Oregon State University Forestry Laboratory to better define the hazards of such disposal from the water quality standpoint. We have plans for both in-house activities and R&D interests in this regard.

Grant and Contract Research

The current status of monitored grants is described below. These grants are in the process of being assigned to work plans.

1. 12040 ELW: Economic Optimization of Aerated Lagoon Treatment. Crown-Zellerbach, Lebanon, Oregon. Final report has been approved.

2. 12040 EMY: Optimization of Secondary Treatment Methods. Mead Corporation, Chillicothe, Ohio. Final report has been approved.

3. 12040 FUB: Reverse Osmosis Treatment of Semi-Chemical Wastes. Green Bay Packaging Co., Green Bay, Wisconsin. Full-scale reverse osmosis treatment of NSSC wastes has progressed through the pilot stage employing Gulf General Atomic, Havens International, American Standard, and Aqua-Chem module configurations for life studies. Bid specifications for the full-scale installation have been finalized and forwarded to the individual suppliers.

Consulting Services

1. A significant amount of time has been involved this quarter in consulting support of EPA and State of Washington action against

ITT-Rayonier at Port Angeles, Washington. The requirement for 85 percent liquor solids removal, primary treatment, and extended outfall and diffuser was finally settled among EPA, Justice Department, State of Washington, and ITT-Rayonier. Similar attention has been devoted to negotiations among EPA, State of Florida, and ITT-Rayonier concerning the Fernandina Beach, Florida, mill. Four conferences have been held with no final decision yet reached. Mr. Scott also provided advisory services to the conferences in relation to the Escambia and Perdido Bay, Florida, conferences involving EPA, Florida, and Alabama. We have also provided consulting services to the State of Alaska concerning the Sitka and Ketchikan pulp mills relative to state permit proceedings.

2. Phil Roush and Kirk Willard have both devoted staff time to examining the developing field of forest fertilization and the effect this may have on surface water quality. Experimental work is underway by Bureau of Land Management, Weyerhaeuser Co., and Crown-Zellerbach in this regard. Aerial spreading of urea is normal procedure. Nitrogen losses through volatilization have approached 40 percent under higher temperature conditions. Phil Roush is conducting a literature search and updating of experience concerning forest fertilization.

Plans for Fourth Quarter, FY 1971

Work Plan GJH: Suspended Solids Removal by Mechanical Means (12040)

Continue with in-house work on suspended solids separation from aerated lagoon effluent. Continue with construction, and

eventual operational phase of the solids separation project at the Crown-Zellerbach mill at Lebanon.

If time and manpower are available, initiate an in-house study on short term series aeration, with sludge return on pulp and paper wastes. This will provide preliminary data for an extension to field operations at Lebanon following conclusion of the solids removal study.

Work Plan GJU: (Special) Operations Support

It is expected that this program will become more involved in helping to develop effluent standards and review of U.S. Army Corps of Engineers Section 13 permit procedures and applications.

Areas of Concern

We have had, for over a year, both a need and work plan for both in-house and R&D grant work on defining the importance and control of fecal coliform multiplying in pulp and paper waste treatment systems with evident increased counts in receiving waters. No microbiologist is available for any in-house work and funds have not been available to underwrite the R&D project with Crown-Zellerbach at Lebanon. Support is needed to carry on the responsibility for in-house activities in this area which is of concern to EPA, state agencies, and the pulp and paper industry.

Work is underway to define the research needs of the hardboard and wood preserving industries.

NATIONAL THERMAL POLLUTION RESEARCH PROGRAM

PPB 1613

Status of Projects and Significant Accomplishments

Work Plan ZFL: Consultation and Advisory Services

Dr. Tichenor and Mr. Christianson were lecturers at the "Thermal Pollution Seminar," which was conducted for the U.S. Bureau of Reclamation in Denver, February 2-3, 1971. This seminar was arranged by EPA's Southwest Region.

In February, Dr. Tichenor traveled to Charlotte, North Carolina, to attend a meeting to discuss cooling water discharge proposed by Duke Power Company for the McGuire nuclear plant to be located on Lake Norman. Representatives of EPA, Duke Power Company, and North Carolina Resource agencies were in attendance at this meeting.

A Temperature Standards Work Group was established by the Commissioner at the request of the Assistant Commissioner for Enforcement and Standards Compliance. Mr. Rainwater is the Secretariat of the group. The first meeting, attended by Dr. Tichenor, was held in Minneapolis, February 9, to discuss temperature standards for Lake Michigan. Mr. Rainwater attended the second meeting of this Work Group in St. Louis. This meeting was relative to the issuance of a permit to Duke Power by North Carolina. Also while in St. Louis, the Work Group participated in the thermal criteria setting meeting on the Mississippi River. In March, Drs. Tichenor and Shirazi, and Mr. Rainwater traveled to Washington, D. C. to evaluate the Florida

Power and Light proposal (for Turkey Point) for the discharge of heated water.

Prior to the Lake Michigan Enforcement Conference, Dr. Tichenor traveled to Chicago (March 9-10) to attend a meeting relative to Lake Michigan temperature standards. His role in this meeting was to evaluate the economic and technical feasibility of alternative positions with regard to restricting the discharge of waste heat from thermal power plants into Lake Michigan. The Enforcement Conference was held March 23-25, and Dr. Tichenor attended as a technical consultant.

The Commissioner approved invitations for Mr. Rainwater to serve as member of Water Quality Committee and Water Research Coordinating Subcommittee of the Electric Power Council on Environment.

In January. Dr. Tichenor provided the Northeast Region with an analysis of the meteorological effects of the cooling towers at the Vernon, Vermont nuclear power plant.

Drs. Tichenor and Shirazi evaluated data supplied by Commonwealth Edison on the cost of backfitting the Zion nuclear power plant with closed-cycle cooling towers.

Mr. Christianson was appointed Project Officer for a contract on the steam generation-electric power industry. This is one industry studied under the WQO "Industrial Waste Studies" survey of major US industries. A briefing meeting was held for project officers on January 19, 1971, in Kansas City, to explain the approach of the studies and describe schedules, requirements, and Project Officer responsibilities. Numerous contacts were made with the contractor,

Freeman Laboratories of Chicago, by telephone and one meeting was held in Chicago on February 5, 1971. Future involvement will include Headquarters meetings of a Technical Review Committee to discuss findings of the contract and to suggest effluent guidelines for this industry, based on data gathered.

Dr. Garton attended a meeting of the EPA National Committee on Biological Methods held in Cincinnati on January 19-21, 1971. The committee is preparing a manual on biological methods to become the Agency standard. Dr. Garton is a member of the Benthos Subcommittee. A first draft of his contribution to the committee report was submitted to the subcommittee chairman on February 10, 1971.

On January 25-27, 1971, Dr. Garton attended the Biological Entrainment Workshop hosted by Johns Hopkins University in Baltimore, Maryland. The Workshop was planned to enable persons working with thermal effects to compare methods and data for assessing entrainment and pumping effects of power plants upon planktonic organisms.

Work Plan ZFC: Heat Transport and Behavior in the Mixing Zone

Outfall Design: An analytical and experimental study of discharges of heated water is being conducted both in-house and extramurally. The discharge is a horizontal, rectangular open channel at the surface of a large ambient body of water which may have a bottom slope or a cross flow at right angles to the discharge. Of interest is the dependence of the temperature distribution in the receiving water as a function of the initial temperature difference between the heated discharge and the ambient water, initial discharge velocity,

the geometry of the discharge channel, the bottom slope, the ambient cross slope, and the transfer of heat to the atmosphere through the water surface.

The theoretical development assumes that the discharge is a three-dimensional turbulent jet with a sheared initial core and a turbulent region in which the velocity and temperature distributions are related to center line values by similarity functions. Horizontal and vertical entrainment of ambient water into the jet is proportional to the jet center line velocity by an entrainment coefficient. The vertical entrainment is a function of the local vertical stability of the jet and the buoyancy of the discharge increases lateral spreading. A cross flow deflects the jet by entrainment of lateral momentum and bottom slope inhibits vertical entrainment and buoyant lateral spreading.

Experiments are performed in a laboratory basin in which all of the relevant parameters including the cross flow and the bottom slope are varied and three-dimensional temperature measurements are taken in the heated discharge.

The experiments verify that the theoretical model predicts the behavior of heated discharges. The theory contains no undetermined parameters and the comparison of the experimental and theoretical results do not involve any fitting of the theory to the data. The rate of temperature decrease in the jet and the vertical and lateral spreading are controlled by the initial densimetric Froude number, the ratio of channel depth to width and the bottom slope. A cross

flow deflects the jet but does not break the average temperature distribution. Heat loss does not significantly affect the temperature distribution in the heated discharge within the region treated by theory.

Application of the theory to prediction of temperatures in an actual heated discharge is possible if the temperatures, velocities, and the geometry of the discharge may be schematized to representative steady state temperatures and velocities and by an equivalent rectangular channel. If a model study is necessary the theory indicates that temperature similarity requires an undistorted model. The theoretical model developed in this study may be extended by treating a stratified ambient condition by considering recirculation of the heated jet in a finer enclosure and by development of a theory for the transition of the heated discharge jet into the buoyant plume.

When considering outfall design better prediction can no longer be expected solely as a result of reducing the computational accuracy. Instead we must increase our knowledge of the hydrodynamics involved.

In a series of laboratory experiments direct measurement of the turbulent coefficients needed and the transport equations were measured directly. The experiments were designed so that the effects of various flow parameters could be separately analyzed. More specifically the objectives of this study are, first, measure the eddy diffusivity at several stations along the plume of a heated jet and a salt water jet in a vertical and horizontal direction, and examine the similarity between the temperature and salinity profiles

and velocity profile in the plume. Second, measure turbulent dispersion as a result of shear flow in the longitudinal direction downstream of the jet. Third, examine the influence of parameters such as jet flow rate, jet temperature, jet velocity, ambient turbulence levels, and ambient shear velocity on the spread of the heated plume and the salt jet. Fourth, establish modeling procedures for correcting the effects of "distorted" turbulent time and space scale in the laboratory experiment for application to field situation.

The results of these studies are being published in an open file basic data report jointly by USGS and EPA.

Work Plan ZFD: Heat Transport and Behavior in Large Hydrologic Systems

Nothing new or significant.

Work Plan ZFF: Engineering and Cost Aspects of Heat Dissipation

The results of measurements made to determine the reflectance and coverage ability of different types of white particles on a water surface were described in a staff report. The reflectance of six candidate materials at different concentrations was measured for wavelengths from .400 to 1.550 microns. The measurements were integrated with respect to the solar spectrum to determine the approximate, average solar absorptivity. Fully expanded polystyrene beads seemed to be the most promising on a cost effectiveness basis. In an effort to reduce the coverage cost, an experimental sample of very small, yet fully expanded, beads was obtained from the manufacturer. In subsequent tests this expanded polystyrene powder

was shown to be as reflective as the larger polystyrene beads and the material cost was reduced to about $70 per acre. This expanded polystyrene powder also seemed unlikely to be blown off the water surface once wet. If a major portion of this material remains effective for about a year, it looks as if it might be practical.

Algae growth tests have been started in the annex. Equipment is being prepared to get a qualitative idea of the effect of wind over a model pond.

A turbulent bed cooling tower has been tested for hydraulics and preliminary heat transfer analysis. The total air pressure drop in the tower is found to heavily influence operating costs. The bed pressure loss, that is the total minus the empty column, is the most critical parameter. It is found that the bed pressure drop is independent of gas velocity given a six particle size liquid loading and a static bed length. This is true in a range of gas rates between just above the minimum fluidizing velocity up to the onset of liquid flooding.

Three bed length, several liquid rates, and two particle sizes were studied as functions of gas rate. Proper use of this information will be made when overall cooling performance is assessed and an economic optimization is performed.

Gas pressure drop is also strongly affected by the weight of liquid permanently held in the bed during study operation. In effect, the gas stream supplies, through dissipation, all the energy required

to hold the liquid in suspension. The pressure drop behavior of the bed suggests that liquid holdup is independent of gas velocity.

Mr. Christianson attended the National AICHE Meeting in Houston, February 28-March 4, 1971. The program included an unusually high number of presentations pertinent to RTPRP work, i.e., cooling tower plumes, drift, operating problems, corrosion control, etc. In addition to the AICHE scheduled presentations, Mr. Christianson discussed the development of a drift measurement technique and device with Environmental Systems, Inc., a grant applicant who has sought technical consultation in this area of high program priority.

Work Plan ZFJ: Beneficial Uses of Heated Water

A meeting was held on February 25, 1971, with representatives of EWEB and VITRO to review progress and plan future work emphasis re the EWEB demonstration project of warm water use in agriculture. With operational experience now in the background, emphasis will now be placed on economics. Attention will be focused on quantifying, in terms of dollars, the actual benefit or detriment of the experimental practices of using warm water for growing numerous crops. Through this approach, the overall economic feasibility of large scale projects may be indicated. Additional meetings were held with VITRO personnel to work out details.

Work Plan ZFI: Advanced Power Generation

An analytical research program was conducted to estimate the technical and economical feasibility of eliminating river and lake water thermal pollution through the use of advanced design open-cycle

gas turbine as the basis for future fossil fueled base load electric utility power generating stations.

An intensive literature review and discussions with power industry representatives were undertaken to estimate the price levels of suitable fuels for power generation, the extent of cooling water shortages, and the operating and cost characteristics of steam power stations and alternative methods for cooling condenser water discharges during the next two decades.

Detailed estimates of the performance, size, and cost characteristics were made for advanced simple-regenerative and compound-cycle gas turbine engines capable of operating a turbine in the temperatures of 2,000°F and above and which are anticipated to be commercially available in the next two decades. Conceptual designs of selected gas turbine engine configurations determined to have the greatest technical and economic potential for providing minimum power costs and an engineering layout of a possible future 1,000 megawatt central power station utilizing gas turbines are included. Estimates and comparisons of complete gas turbine and steam turbine power station installed costs and total busbar power costs were made for the various regions of the U.S.

The results indicate that the gas turbines which will become available in the 1970 decade could produce electric power at lower costs than steam turbine in the south central region of the U.S. where natural gas is readily available while eliminating river and lake thermal pollution. In other regions of the U.S., the gas

turbines would be economically competitive if moderately priced clean fuels are available. The competetive position of advanced gas turbines will be further enhanced during the 1980 decade as anticipated increases in turbine inlet temperature component efficiencies and material permit substantial improvements in overall engine performance and larger engine designs leading to more efficient and lower cost engines and power stations.

Although the development costs for large advanced gas turbines will approach from 100 to 200 million dollars, the total amount that utilities are expected to expend for cooling devices to combat thermal pollution over the next two decades will exceed more than 10 times this amount. Thus, advanced gas turbines should be given serious consideration for increased research and development support.

Grant and Contract Research

Work Plan ZFF: Engineering and Cost Aspects of Heat Dissipation

The contract with Dynatech R/D Company (12014-477) was completed and two reports were entered into the Water Pollution Control Research Series in January: (1) 16130DHS11/70 -- "Total Community Considerations in the Utilization of Heat Rejected from Thermal Power Plants," and (2) 16130DHS01/71 -- "System Selection, Design, and Optimization."

Work Plan ZFD: Heat Transport and Behavior in Large Hydrologic Systems

The final report, "Research on the Physical Aspects of Thermal Pollution," from the contract with Cornell Aeronautical Laboratory (14-12-526) was entered into the Water Pollution Control Research Series under the number 16130DPU02/71.

The final report, "A Predictive Model for Thermal Stratification and Water Quality in Reservoirs," Massachusetts Institute of Technology was entered into the WPCRS under the number 16130DJH01/71.

Work Plan ZFL: Consultation and Advisory Services

The final report "Potential Environmental Modifications Produced by Large Evaporative Cooling Towers," under contract #14-12-542 to EG&G, Inc., was entered into the Water Pollution Control Research Series under the number 16130---01/71.

Work Plan ZFC: Heat Transport and Behavior in the Mixing Zone

The final report, "An Analytical and Experimental Investigation of Surface Discharge of Heated Water, Massachusetts Institute of Technology, Grant 16130 DJU, was entered into the Water Pollution Control Research Series under the number 16130DJU02/71.

Other significant publications relative to the Vanderbilt University grant (16130 FDQ) are:

1. Benedict, Barry A., Edward M. Polk, Frank L. Parker, Louis H. Motz, and John E. Edinger, "Movement of Heated Water Discharges from Power Plants in Man-Made Lakes," to be presented at the symposium on Man-Made Lakes -- Their Problems and Environmental Effects sponsored by the Scientific Committee on Water Research in Knoxville, Tennessee, May 3-7, 1971.

2. Benedict, Barry A., Edward M. Polk, Edgar L. Yandell, & Frank L. Parker, "Surface Jet & Diffusion Models for Discharge of Heated Water," to be presented at the 14th Congress of the Interantional Association for Hydraulic Research in Paris, August 29-September 3, 1971.

3. Benedict, Barry A., Louis H. Motz, and Edgar L. Yandell, "Use of Heated Surface Jet Model for Lake Michigan Analysis," submitted to the Journal of Water Pollution Control Federation for publication.

4. Polk, Edward H., Barry A. Benedict, and Frank L. Parker, "Cooling Water Density Wedges in Streams," submitted for publication in ASCE, Journal of the Hydraulics Division, 1971.

Continuing Projects

Work Plan ZFF: Engineering and Cost Aspects of Heat Dissipation

Environmental Systems Corporation, 16130 GNF, "Quantitative Measurement and Continuous On-Line Monitoring of Drift from Salt or Brackish Water."

Purdue University, 16130 EMQ, "Turbulent Bed Cooling Tower."

The Center for the Environment and Man, Inc., 16130 ERN, "Economic Analysis of Thermal Pollution Abatement Costs in the Electric Power Industry."

Washington State University, 16130 FLH, "Analysis of Engineering Alternatives for Environmental Protection from Thermal Discharges."

Work Plan ZFC: Heat Transport and Behavior in the Mixing Zone

Oregon State University, 16130 DGM, "Thermal Plume Dispersion."

St. Anthony Falls Hydraulic Laboratory, 16130 FSU, "Mixing and Dispersion at a Warm Water Outlet."

Vanderbilt University, 16130 FDQ, "Project for Concentrated Research and Training in the Hydrologic and Hyraulic Aspects of Water Pollution Control."

Work Plan ZFD: Heat Transport and Behavior in Large Hydrologic Systems

Cornell University, 16130 DIP, "Heat and Water Vapor Exchange Between Water Surface and the Atmosphere."

Oregon State University, 16130 FOK, "Controlling Thermal Pollution in Small Streams."

Work Plan ZFJ: Beneficial Uses of Heated Water

Eugene Water and Electric Board, 16130 EIK, "Thermal Water Demonstration Project."

Consulting Services

See "Status of Projects and Significant Accomplishments," Work Plan ZFL.

Reports, Papers, and Presentations

1. Garton, R. R. and Christianson, A. G. "Beneficial Uses of Waste Heat -- An Evaluation." Presented at the Conference on Beneficial Uses of Thermal Discharges, September 17-18, 1970, Albany, New York. Entered into the Water Pollution Control Research Series January 14, 1971.

2. Tichenor, B. A. and Christianson, A. G. "Cooling Pond Temperature vs Size and Water Loss." Presented at the ASCE National Water Resources Engineering Meeting, Phoenix, Arizona, January 11-15, 1971. Paper accepted for publication in ASCE, Journal of the Power Division, July, 1971.

3. NTPRP "State-of-the-Art Newsletter, No. 2." January 1971.

Plans for Fourth Quarter, FY 71

Work Plan ZFL: Consultation and Advisory Services

Mr. Christianson will participate as guest lecturer in a training course sponsored by the Manpower and Training department entitled "Field Investigations and Sampling Techniques."

The Temperature Standards Work Group will participate in meetings with Regional, State and Headquarters people to finalize temperature standards for California and New York.

Work Plan ZFC: Heat Transport and Behavior in the Mixing Zone

A contract is being prepared for construction of the hydraulic flume.

NATIONAL COASTAL POLLUTION RESEARCH PROGRAM

PPB 1607

Status of Projects and Significant Accomplishments

Work Plan DBH: Estuarine and Ocean Outfalls

Columbia River Estuary Temperature Model. Part II of the Columbia River model report ("Input-Output and Preliminary Verification") was completed, reviewed, and typed in final form.

Selection of Safe Sites for Discharge. Present effort is directed toward gathering information relative to the construction and maintenance of estuarine and ocean outfalls. The objectives of our current effort are the determination and isolation of (1) a basic cost or cost range for the various types of ocean outfalls and diffusers, and (2) the physical and environmental factors pertinent to a sound design and construction procedure. The role of these parameters will be assessed for route and construction method selection, and included in an analysis of the probability of structural or performance failures from wave and earthquake forces.

Work Plan XAA: Barge Dump Disposal of Wastes in Ocean and Coastal Waters

Equipment and Instrumentation. We received and accepted delivery on an underwater acoustical tracking system manufactured by Oceanonic Enterprises of San Diego, California.

Designation of Harmful Materials. Trace materials introduced in coastal waters continues as the primary effort.

Arrangements are being made to invite Marko Branica of Yugoslavia to visit in our laboratory with PL 480 funding. Dr. Branica, who is

a world authority on trace metals in coastal environments subject to pollution, has agreed at the personal level to visit and help us initiate certain trace material work using polarographic methods.

A polarographic laboratory system has been designed and bids requested for this system or its equivalent.

A gas chromatography mass spectrometer system has been specified as an essential laboratory facility for our trace materials in wastes disposed to coastal waters. Acquisition has been requested for FY 72.

Grant and Contract Research

Work Plan 3B11: Estuarine and Ocean Outfalls

1. 16070 FKO: The Significance & Control of Wastewater Floatables in Coastal Waters. The second quarterly progress report for grant 16070 FKO to Dr. Selleck at Berkeley was received. Progress was in accordance with the stated work schedule and all collection devices have been designed and tested. Field work is scheduled to start no later than April 1, 1971.

2. 16070 DZV: SOA Report on Simulation of Pollution Problems & Controls in Estuaries. Tracor's final report on the state of the art of estuary modeling was reviewed and Tracor was instructed to forward the final copy to Project Reports System, thus completing contract 16070 DZV.

3. 16070 DEP: Turbulent Diffusion in Liquid Jets. Experimental work on this project at Purdue University was completed this quarter, and results of the work are being incorporated into a final report expected to be completed in the fourth quarter.

4. 16070 FJV: Coastal Pollution: Literature Search. Indexing and Abstracting. Approximately 200 abstracts relating to coastal pollution were submitted to the WRSIC, with copies to NCPRP, from the grantee, Pollution Abstracts, Inc. This represents roughly 25 percent of the total expected number of abstracts to be prepared by the grantee.

5. 16070 EFG: Demonstration of the Limitations and Effects of Waste Disposal on an Ocean Shelf. Florida Ocean Sciences Institute continues to revise and incorporate the project officer's suggestions in the final report on their project.

6. 16070 ENS: Airphoto Analysis of Ocean Outfall Dispersion. A paper entitled, "Aerial Photographic Study of Ocean Outfalls," was prepared for presentation at the Offshore Technology Conference to be held in Houston, Texas, in June. Field work continued on computation of dispersion coefficients using aerial photos of dye patches.

Work Plan XAA: Barge Dump Disposal of Wastes in Ocean & Coastal Waters

16070 EKZ: Oxidation of Organic Matter in the Seabed. Pollution of Puget Sound seems a clear danger if not a present danger. The input of various sewage (digested) sludges is over 10^5 lbs/day and the oxygen consumption of these materials accumulated on the seabed is a reasonable indicator of the mechanisms prevailing there and their future behavior. We are seeking by this grant to the University of Washington Dept. of Oceanography to obtain quantitative relationships between physical, chemical, and biological processes and the oxygen consumption. The influence of these criteria to the regulation of dumping and dredging on objective grounds is clearly essential. To date the oxygen uptake

by COD and BOD has been determined at 13 stations in 1970 and will be extended to 33 in 1971. These measurements provide benchmark data for Puget Sound as well as the nature of the processes occurring at this time.

The additional input from the lumber industry and the movement of these materials accompanying Corps of Engineers dredging operations constitute problem areas for continued close observations.

16070 DCD: Oxygen Uptake of Benthic Organisms in the Presence of Varying Degrees of Bottom Sludge Agitation and Various Temperatures and Salinities. The final report on this grant study regarding oxygen uptake of benthic organisms was approved and forwarded to the Project Reports System. The study was conducted by Dr. Richard Berg of Seattle University.

Work Plan XCF: Tidal Flats in Estuarine Water Quality Analysis

16070 DGO: Tidal Flats in Estuarine Water Quality Analysis. Under the direction of Dr. Bella, Oregon State University, an ecological model of exchange in the marine sediment-water interface is being developed, using the sulfur cycle as an indicator of processes in the sediment layer and within the water column. The releases of free sulfides from sediments can cause complications relating to binding by mercury and stripping of oxygen in the water columns. Exchange processes are simulated in a numerical model of the system; field studies in an estuarine mud flat and laboratory experiments are used to develop the model. Michaelis-Menton kinetic reactions are utilized

where applicable; feedback and initial numerical experimentation is performed through an analog-digital programing system.

Consulting Services

Work Plan ZAR: Technical Consultation on Coastal Pollution Problems

1. The program provided consulting services to the Northwest Regional Office on the design of Georgia Pacific's waste discharge diffuser in Bellingham Bay.

2. Technical assistance was provided to the Lake Superior enforcement conference by review of proposed discharge plan for Reserve Mining Company.

3. A staff member conferred with Regional Office personnel regarding proposed testimony, based on work performed with the Regional Office previously, on the case of ITT-Rayonier vs. the State of Washington.

4. A staff member provided assistance to the Department of the Interior by recommending scientists outside the Government to review and make comment on a mathematical model of Biscayne Bay, Florida, which was contracted by the Parks Department.

5. At the request of the Chief, Engineering Branch, material was compiled on program accomplishments during the past year for inclusion in a reply to questions raised by Senator Muskie.

6. At the Laboratory Director's request, a review and an evaluation were made on the Project Reports System report specifications.

7. Additional assistance was provided a Swedish engineering firm in their attempts to design an ocean outfall system for the City of Gothenburg, Sweden.

8. Review and comments were sent to the Southeast Region's Grant Program Director on a report entitled, "Diffusion from Ocean Outfalls off the Florida Southeast Coast."

9. A supplemental budget request was submitted from headquarters for additional funds for research in support of the ocean dumping permit authority suggested by the report, "Ocean Dumping," prepared by the Council on Environmental Quality. A budget and program plan were submitted at the request of the Chief, Engineering Branch.

10. The Food and Agricultural Organization of the United Nations requested and received a review of the seminar report on biological monitoring prepared from the recent FAO marine pollution conference.

11. A staff member represented the program at the second session of the Biological Advisory Committee meeting held in Cincinnati January 19-21 to aid in preparation of a biological methods manual.

12. At the request of the Laboratory Director, the Director, Office of Environmental Studies, UCLA, was supplied with reports and references on "man-induced nutrients" relating to coastal pollution.

13. The New England River Basins Office was furnished a card input list for QUALTEMP and part of the output for a test run for use in their studies.

14. At the request of the Lockheed-California Company, a report on time series analysis, Coast Guard Data Buoy Project, was reviewed and comments made.

Reports, Papers, and Presentations

1. The second draft of a paper describing the overall scope of the National Coastal Pollution Research Program was forwarded to the Chief, Engineering Branch, for review.

2. Working Paper #80, "User's Guide and Documentation for Outfall Plume Model," was completed and sent out for technical review.

3. A paper entitled, "Applications of Some Numerical Models to Pacific Northwest Estuaries," was presented at the OSU Technical Conference on Estuaries of the Pacific Northwest by Chief, Physical Oceanography.

4. Program Chief chaired a session on coastal and oceanic pollution at the 161st National American Chemical Society Meeting in Los Angeles, California.

5. Program Chief participated in the third session of GESAMP in Rome, Italy, under the sponsorship of the Food and Agricultural Organization of the United Nations in Rome.

6. Chief, Chemical and Biological Oceanography, participated in the Gordon Research Conference on Chemical Oceanography held in Santa Barbara, California.

Training

1. Four staff members completed a 40-hour training course on small boat handling presented by Linn-Benton Community College.

2. A staff member completed a one-week training course entitled, "Basic Management Techniques I" sponsored by the U. S. Civil Service Commission.

Plans for Fourth Quarter, FY 1971

Work Plan DBH: Estuarine and Ocean Outfalls

Principal effort will be directed toward the development of base cost data for ocean outfalls with some consideration given to the breakout of the location and distribution of outfalls from major sewage treatment facilities.

Work will begin on a section of Part II of the ocean outfall report relating to passive diffusion pollution models. Existing models will be examined with regard to the underlying assumptions, history of success and use, ease of use, and range of application.

The paper entitled, "Application of some numerical models to Pacific Northwest Estuaries," given by a staff member at the OSU Technical Conference on Estuaries, will be published by the Engineering Experiment Station.

Work Plan XAA: Barge Dump Disposal of Wastes in Ocean and Coastal Waters

We will continue our fully instrumental analyses on appropriate samples with detailed wet radiochemistry as manpower permits.

CONSOLIDATED LABORATORY SERVICES PROGRAM

Status of Projects and Significant Accomplishments

General

The OSU-PNWL graduate fellowship program produced a thesis "The Pressure and Temperature Effects on the Solubility of Nitrogen in Distilled Water." The thesis was accepted as partial fulfillment of the requirements for the degree of Master of Science in the Chemical Engineering Department. The subject matter of the thesis is important information for evaluating effects of nitrogen in water on salmon.

The CO_2 - N_2, O_2 field gas chromatograph was assembled and field tested. The field testing indicated that it is essential to provide stable voltage to the detector and recorder system. The voltage and amplitude will be provided by a special package designed to give stable voltage.

The evaluation of the Oceanography International total carbon system has been completed. Data collected from the evaluation is being assembled for preparation of report.

The radiometer titration system was made operational and it will produce graphical records of potentiometric titrations.

The bookkeeping aspects of laboratory operation are now more completely controlled by computer programed systems. The sample data sheet and analytical request information is teletyped to the computer when the sample is received. The computer catalogs a listing of analysis, produces bench sheets for analysts, provides backlog

information, and informs staff when all analyses are completed so that samples can be thrown away.

Automated Analytical Systems

The Technicon II system has been delivered, set up, and is now operational. Modules for analysis of ammonia-nitrogen, orthophosphate-phosphorus, nitrite nitrogen, nitrate nitrogen, and soluble silica are functioning, using dual channel system. Analyses are performed at the rate of 50-60 samples per hour using 0.5 ml of sample per analysis. Thus, with 10 ml of sample, five constituents can be run by use of the same sample tray and change in module. The Technicon II also has a linearized recorder, a programed peak picker and a digitized output of data. It is now unnecessary to measure peak heights as a function of concentration the data acquisition system provides output in concentration terms.

Samples that contain suspended material require distillation to accurately determine ammonia nitrogen concentration. A distillation system is now being used as pretreatment in the automated analysis of ammonia nitrogen.

Atomic Absorption Spectrophotometry

Two Instrumentation Laboratories Atomic Absorption Spectrophotometers model 353 have been received and are being put into operation. The new equipment was purchased to replace two IL model 153 units which were showing signs of wear.

Specialized Analysis

During this quarter the specialized analysis group, with assistance from all other sections, concentrated its efforts on analysis of plants and sediments for carbon, nitrogen, hydrogen, and phosphorus. The Analytical Quality Control program pointed out some problems in analysis of phosphorus in plant samples. As a result of problems, a considerable number of samples required phosphorus reruns.

Analysis of Carbon

The Beckman-Carbonaceous Analyzer is now being used for routine total carbon and inorganic carbon analysis. The Oceanographic instrument is used for specialized analysis at low levels and for organic carbonate in the particulate fraction. The backlog for carbon analysis is now less than fifty analyses. The CHN analyzer is being used for analysis of carbon, hydrogen and nitrogen in dried samples.

Kjeldahl Analysis

All Kjeldahl analysis are now being run on samples as they are received. There is no backlog in the Kjeldahl section.

Biology

Routine samples were analyzed from Eutrophication Research Program and Technical Operations Program.

Microbiology

Routine samples from Pollution Surveillance and National Waste Treatment and Control Research Program were handled.

Areas of Concern

Communications on priorities are causing some concern. Immediate answers can be provided for water samples relatively free of interference for a selected group of metals at a specific level, and for forms of carbon, nitrogen, and phosphorus. CLS cannot provide everyone with this type of service at the same time. Thus priorities must be established in the planning phase and time must be allocated for planning purposes.

Reports and Papers

Presentation and demonstration of turbidity measurements were made before the Department of Transportation, Federal Highway Projects Division at Vancouver, Washington.

Chief of CLS discussed with Columbia River Water Management Group the analytical determination of nitrogen in water and the use of instrumentation to accomplish analysis.

Equipment

Backup equipment should be acquired for CO_2 - N_2, O_2 analysis. Computer tie-in of titration equipment and Atomic Absorption spectrophotometric equipment should be investigated.

Plans for Fourth Quarter, FY 1971

Appropriate steps will be taken to reduce backlog. Necessary implementation to provide more rapid response will be put into operation, especially to programs that require this type of information.

TRAINING AND MANPOWER DEVELOPMENT

Status of Projects and Significant Accomplishments

Direct Training

"Membrane Filter Workshop"	Portland, Ore.	Feb. 9-10	18 students
	Olympia, Wash.	Feb. 16-17	28
	Auburn, Wash.	Feb. 18-19	33
	Yakima, Wash.	Feb. 23-24	25
"Survey Sampling for Managers"	Portland, Ore.	Feb. 11-12	39
	Olympia, Wash.	Feb. 9-10	24
"Data Evaluation & Analysis"	Corvallis, Ore.	Mar. 15-19	28

A staff member assisted in the instruction of students at the annual Idaho Department of Health short school, Pocatello, Idaho, January 25-29, 15 students.

Training facilities were used for a motorboat operator training course for Laboratory personnel which consisted of weekly 3-hour sessions for 10 weeks. Students from the sewage treatment plant operators short course at Oregon State University spent two days in the training facilities for lectures and laboratory instruction. A staff member provided nine hours of lecture and demonstration for the sewage treatment plant operator course at Linn-Benton Community College.

Manpower Development

Contacts have been made to initiate a project Transition program for training service men at McChord AFB to become sewage treatment

plant operators. The training period will be 16 weeks in length and will be conducted by the Clover Park Technical School in Tacoma.

Linn-Benton Community College has been selected as one of three community colleges in the nation to participate in a pilot program in the development of a two-year waste water treatment plant operator training program. Graduates from this program will receive an Associate of Arts degree.

A Department of Labor representative, Washington, D. C., visited the DOL funded (through Water Quality Office national contract) program for training sewage treatment plant operators in Portland, Oregon and also Linn-Benton Community College. A subsequent report was very favorable and indicated these programs were among the best the representative had seen.

Public Relations

Tours and orientation were provided for 165 people; staff provided speaking services before groups totaling 460 people. Films and slides/tapes were loaned for viewing by over 1500. Over 1200 pieces of literature were distributed.